Chapter 1

INTRODUCTION

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INTRODUCTION

Unimak Pass is the major passage linking the northeastern Pacific Ocean to the eastern Bering Sea. It also lies on the great circle route between the Orient and the west coast of North America. It is trafficked by fishing and cargo vessels, tankers, barges, and warships. Oil industry vessels supporting offshore exploratory activities in western and northern Alaska transit the pass. In the event of a major oil discovery, tanker and support vessel use of the passage is expected to markedly increase, thus increasing the probability of accidents which could result in oil spillage and regional damage to biota.

In anticipation that portions of the Bering Sea (St. George Basin, North Aleutian Shelf, Navarin Basin, Norton Sound) were to be leased for petroleum exploration, a series of meetings was convened over the past several years to assess the status of environmental knowledge of these areas. The syntheses resulting from these meetings were used to evaluate the environmental hazards to and potential environmental damages from activities in the leased areas. Although spatially removed from the actual lease areas, Unimak Pass was consistently identified as a region of utmost biological importance and was considered to be potentially at risk from outer continental shelf (OCS) activities in any or all tracts. Information needed for understanding of the biological processes in the pass were identified and additional research recommended.

The Unimak Pass area is perceived to have relatively high habitat values, as suggested by consistently intensive use by seabirds and marine mammals. Reconnaissance surveys by the U. S. Fish & Wildlife Service indicate that, in summer, well over one million seabirds nest on islands in the area. During spring and fall, millions of birds and thousands of marine mammals migrate through the pass. Large numbers of these apex predators feed in the area throughout the year, which is suggestive of high and sustained productivity. A lack of quantitative information on the nature and extent of use of the Unimak Pass area by marine birds and mammals has prevented NOAA and MMS from adequately determining the risks posed to bird and mammal populations by current activities or by the increased activity that might result from OCS oil and gas development.

As a first step toward filling information needs, OCSEAP in summer 1985 initiated a review of available data related to the Unimak Pass environment. This review (Truett and Craig 1986) described to the extent possible the faunal distributions in the pass area.

Based on this review and previous synthesis meetings, NOAA identified research needed to provide a better understanding of the important ecosystem processes in the Unimak Pass area, with special reference to marine birds and mammals. The objective of the research was to enable managers to

predict the ecological effects of man's activities in the area. In response to this need for additional information, OCSEAP issued a solicitation (Number WASC-86-00074) for proposals to conduct research. A contract was subsequently awarded to LGL Alaska Research Associates, Inc. This report describes the results of the research conducted under this contract.

OBJECTIVES

The goal of this project was to develop information that could be coupled with oil spill trajectory predictions to assess risks posed to marine birds and mammals by OCS oil and gas activities in the Unimak Pass area. The specific objectives were to:

(1) Characterize the seasonal intensity of use of Unimak Pass habitats by marine birds and mammals, identifying particularly important concentration areas;

(2) Relate the seasonal distributions, abundances, and activities of marine bird and mammal species to insular and persistent oceanographic features such as currents, tiderips, and upwelling areas;

(3) Evaluate the vulnerability of marine birds and mammals to oil spills in the Unimak Pass area in terms of individual species abundances, locations, seasons, species' sensitivities to oil, and Alaska and world population sizes; and

(4) Investigate nocturnal seabirds at nesting colonies in the Krenitzin Islands with a view to improving census techniques.

CONTENT OF THE REPORT

The primary emphasis in this study was placed on determining the distributions and abundances of marine birds and mammals. One of our overall objectives, however, was to relate the distributions of these organisms to features in their environment. To do this necessitated considerable study effort in describing the marine habitats that were sampled for birds and mammals. In particular, we attempted to characterize oceanographic conditions, especially the spatial extent of various water masses and the occurrence of areas of marine upwelling. Further, we looked for patterns in the distributions of key prey species (zooplankton and forage fish) that might provide insights as to how the oceanographic features could be influencing bird or mammal distributions.

The descriptions of the physical environment and the prey resources of the study area provide an important background for the chapters on birds and mammals. These background chapters are not intended as exhaustive disciplinary summaries; rather, they focus on information expected to help explain bird and marine mammal distribution patterns.

The report contains the following chapters:

(1) INTRODUCTION
(2) PHYSICAL PROCESSES AND HYDROGRAPHY
(3) ZOOPLANKTON ABUNDANCE AND DISTRIBUTION
(4) FORAGE FISH ABUNDANCE AND DISTRIBUTION
(5) MARINE BIRD ABUNDANCE AND HABITAT USE
(6) MARINE MAMMAL ABUNDANCE AND HABITAT USE
(7) COASTAL MARINE BIRDS AND MAMMALS
(8) SEABIRD COLONIES
(9) ABUNDANCE, DISTRIBUTION, AND VULNERABILITY TO IMPACT OF BIRDS AND MAMMALS: A SYNTHESIS
(10) APPENDICES

STUDY AREA

The study area encompassed Unimak Pass and adjacent waters within a distance of approximately 50 km, including the Krenitzin Islands group. The limits of the area of interest were defined by the rectangle bounded by latitudes 53°30'N and 55°00'N and longitudes 164°00'W and 166°30'W (Fig. 1).

RESEARCH APPROACH

Several criteria were used in designing the research approach. These are briefly described below.

(1) The general scope of work described in the solicitation. Although seemingly self-evident, this research unit is not simply a continuation of previous study efforts in the area, nor is it intended to fill all data gaps relating to all birds and marine mammals.

(2) The species and groups of emphasis. The approach was intended to optimize collection of data relating to the key study species. Key species were selected based on expected abundances in the study area and expressed interests by NOAA. Data on other species were also collected as long as this did not detract from fulfillment of the primary objectives. In terms of bird and marine mammal surveys, this meant that observers recorded all birds and mammals

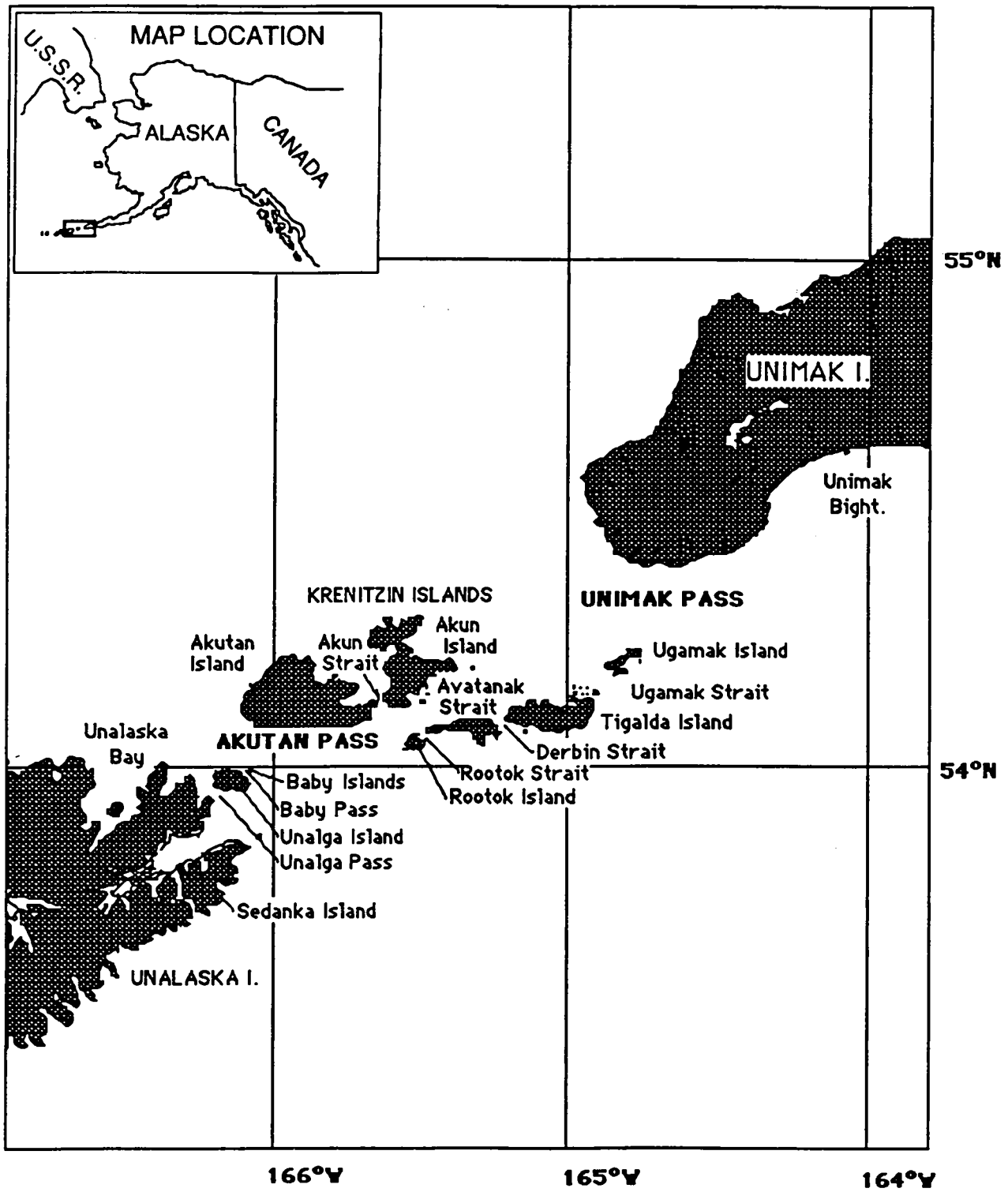

Figure 1. Place names in the Unimak Pass study area, Alaska

seen, but that spatial coverage and intensity of sampling was intended to maximize information obtained about the key species.

(3) The desirability of developing hypotheses for testing. Experience in other programs, such as the North Aleutian Shelf study (LGL 1987), has shown that addressing specific objectives in the form of questions or hypotheses provide answers that permit critical evaluation of the research project and its success. Very general objectives such as describing the distributions and abundances of marine birds have no logical termination; such programs are easy to design but hard to evaluate. Our approach was to derive a set of specific hypotheses we wished to investigate and to design research appropriate for testing them. Collection of general distribution and abundance data was accomplished only as convenient during the process of addressing specific hypotheses.

(4) The desirability of determining causes for observed distributions. As part of several research programs in the Bering Sea, bird and mammal data have been collected concurrently with oceanographic or other biological information (e.g., PROBES and North Aleutian Shelf studies). These studies had developed hypotheses about bird/mammal distributions in relation to such features as fronts, upwellings, and prey concentrations. It was desirable that this study provide direct evidence for testing various hypotheses about such associations, e.g., do auklets aggregate in areas of zooplankton concentration that result from upwellings? Our approach was to collect ancillary data from other disciplines, especially oceanography and zooplankton and fisheries ecology, in a manner and location that would help determine reasons for observed bird/mammal distributions.

In summary, our general approach was to conduct an interdisciplinary study focused on answering specific questions about why key species distributed themselves in specific ways within the study area. By virtue of the platfrom provided and the opportunity it offered for sampling oceanographic phenomena and prey availability, the proposed program was a predominantly shipboard study.

STUDY ELEMENTS

The proposed field sampling effort had five components. These were (1) broad-scale marine surveys for birds and mammals, (2) environmental

characterizations of the marine areas surveyed, (3) detailed characterizations of areas of high use by birds, (4) surveys of birds and mammals near coastlines, and (5) seabird colony studies.

Broad Scale Surveys

This component of the program dealt directly with fulfillment of the first objective of the requested work--to characterize the seasonal intensity of use of Unimak Pass habitats by marine birds and mammals, identifying particular concentration areas. The work was conducted as a series of broad-scale surveys to measure bird and marine mammal abundance in area habitats. This effort comprised the major attempt to collect distribution and abundance information on a seasonal basis. The questions to be addressed by this effort included:

(1) How did the passes between the Bering Sea and Pacific Ocean compare in terms of their usage by the key species?

(2) What were the marine habitat preferences, by season, of the key species?

(3) What factors (biotic, oceanographic, and geographic) were the best predictors of abundance of key species?

(4) How did abundance of key species vary on a seasonal basis?

Transects were distributed by habitat and sampled during three seasons--fall (September), winter (January-February), and spring (April-May). We arbitrarily delimited habitats by criteria we believed would influence bird and mammal distribution and that could be spatially defined. The two main criteria we used were (1) horizontal location with respect to the islands and passes and (2) water depth.

Surprisingly few studies are available that demonstrate predictable affinities of birds and mammals with any but gross categories of marine habitats (e.g., coastal, nearshore, shelfbreak). That is, statistical associations with oceanic domains have been demonstrated, but physical parameters measured have tended to explain relatively little variability in abundance. The importance of prey abundance, oceanographic features (water temperature, depth), and proximity to geographic features (seabird colonies, Izembek Lagoon, and Unimak Pass) in determining seabird abundance were evaluated in preliminary analyses for the North Aleutian Shelf studies (LGL, unpubl. data). Location features, especially the nearness to Unimak Pass, appeared to be the most important predictors of seabird abundance. The distributions of some birds (e.g., Common Murre, seaducks, Leach's Storm-Petrel) are known to be related to water depth. General observations of the

distributions of some of the prey (e.g., benthos) of birds and mammals suggest further that water depth is an important habitat criterion.

Based on these apparent animal/habitat relationships, we subdivided ship-navigable parts of the study area into "habitats" to be surveyed. Our initial classification was a nested one. The top level of this classification consisted of three geographic zones—a central band comprising the passes and inter-island straits, Bering Sea waters, and Pacific Ocean waters. Within each of these zones, habitats were subdivided by depth class, delimited as <50 m, 50-100 m, 100-200 m, 200-400 m, 400-800 m, >800 m. There is an insignificant portion of Unimak Pass >100 m, and depths >800 m occur only in the Pacific Ocean part of our study area. In the analyses presented within this report, this habitat breakdown is refined.

The passes and straits zone was spatially heterogeneous in habitat qualities (e.g., distances from islands, passes, colonies). We sampled the various passes (Unimak, Akutan, Unalga, and Baby) and straits (Akutan, Avatanak, Derbin, and Ugamak) and compared their relative use by birds. Unimak Pass was subdivided into eastern, central, and western parts because we already knew marine organisms to use these parts differently. For example gray whales are restricted to the east side of the pass, but humpback whales are found largely on the west side.

We recognized the Pacific Ocean side of Unimak Pass as being different from the Bering Sea side for two reasons. First, the passes are quite shallow relative to areas to the north and south, and species preferring deeper waters may treat the passes and straits zone as a barrier, and thus inhabit depth zones in only one region. The two oceanic zones also differ in large-scale oceanographic characteristics, most notably in the spatial extent of areas of upwelling and in the presence of distinct current systems.

We did not propose to occupy a set of fixed transects during every cruise. We anticipated that the vagaries of weather in the study area would frustrate any attempt to accomplish too rigid a sampling design. Rather, we proposed to conduct similar levels of sampling intensity among zones. This permitted a more flexible sampling schedule; e.g., during major storms we moved the ship to alternate sides of the Aleutian chain as required. It proved possible to repeat most major survey lines during each cruise; hence there was a great deal of overlap in sites sampled among cruises.

Environmental Characterization

Sampling to characterize oceanographic conditions and prey availability was usually done at night. This sampling included periodic bongo net samples (oblique and horizontal) and CTD casts. Surface prey samples were also taken, initially with a tucker trawl until this device was irreparably damaged. Surface bongos were later substituted. Abundance and

species composition of forage fish were sampled using a Marinovich mid-water trawl. Most sample stations where CTD, zooplankton, and fish samples were collected were reoccupied on each cruise.

Characterization of High-Use Areas

Areas of pronounced concentration in bird use were subjected to more intensive sampling of environmental conditions and/or collections of birds for food habits analysis. Extra sampling generally entailed spatially restricted night sampling, occupation of a station for most of a day (or 24 hrs), or supplemental daytime sampling.

We did not perform a large-scale feeding study of marine birds; however, some collecting of marine birds for food habits analysis was required to compare what they ate with relative abundances of prey items available. Specific diet-related questions addressed were:

- What are the Crested Auklets eating when they are in their winter flocks? The most likely alternatives were copepods or euphausiids. If the birds were eating copepods, we proposed to identify the prey to species, because particular copepod species are associated with specific water masses. These data would provide indirect information on sources of the water in which the birds were feeding.

- What is the principal prey of the murres in winter? Food habits of murres have been intensively studied and we would expect that the large flocks of primarily Common Murres would prey on forage fish. Fisheries investigations in the area of interest have failed to find appreciable quantities of forage fish in winter; therefore, it seemed possible that the murres ate invertebrates in winter.

- What is the most important component in the diet of the late summer aggregations of shearwaters? In the nearby North Aleutian Shelf, shearwaters appear to shift from a diet of euphausiids at the start of the season to fish (sand lance) by the end of their stay (Troy and Johnson 1987). Methods to measure the distributions of these two groups of potential prey are quite different; hence it seemed necessary to collect shearwaters to determine which prey group should be measured.

Surveys in Coastal Environments

The preliminary list of key species included several—seaducks, Glaucous-winged Gull, sea otter, and Steller sea lion—that are primarily

coastal and ineffectively sampled by shipboard surveys. Our approach to survey these groups was to conduct small boat surveys following the coastline of the islands in the Krenitzin group, censusing and mapping locations of these species.

Colony Studies

The seabird colony studies in the Krenitzin Islands, funded incrementally as Phase II of this investigation, formed a rather discrete study unit not closely linked to the marine investigations.

CRUISE SUMMARY

Three cruises were dedicated to this study. These cruises, all using the NOAA ship R/V Miller Freeman, were as follows:

MF-86-10	18 September 1986-7 October 1986	fall
MF-87-02	14 February 1987-9 March 1987	winter
MF-87-05	21 April 1987-14 May 1987	spring

Summary maps showing the approximate locations of stations occupied for taking various samples and measurements appear in the disciplinary sections that follow. A complete listing of the types and location of the samples taken is provided in Chapter 10. APPENDICES (this volume).

LITERATURE CITED

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